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APPLICABILITY OF THE CONCEPT OF MAXIMUM SUSTAINABLE YIELD

Working paper submitted by the delegation of Ukraine for the Working Group on the concept of maximum sustainable yield

1. In the present circumstances, when the harvesting of the living resources of the world's oceans in a number of regions has reached the maximum possible level, one of the main concepts of the theory of fishing - regulating the catch - has become vitally important for the organization of the further optimum exploitation and conservation of the living resources of the sea.

2. Article 61, paragraph 3, and article 119, paragraph 1 (a), of the United Nations Convention on the Law of the Sea, which define the approaches to the utilization and conservation of the living resources in exclusive economic zones and the high seas, specify the reference point of maximum sustainable yield (MSY) as the basis for fisheries regulation and management.

3. At the present time, MSY is the most widely used reference point in the world for fisheries regulation and management. The regulation of the catch in accordance with the concept of MSY is based on a single-species approach to modelling and fisheries management. On the purely theoretical level, the MSY concept reflects the view that it is essential, in order to conserve the effective productivity of fishery stocks, to exclude from the catch only that part which might be offset by the reproductive potential of the population and its capacity to increase the biomass.

4. According to existing definitions, maximum sustainable yield (MSY) is the average size of the largest yield which could be taken from a stock over a prolonged period of time under existing environmental conditions; a balanced yield, corresponding to the level of maximum productivity of a given population (stock); or the largest balanced yield which could in theory be obtained from a given population (stock).

5. In employing the term MSY, we have in mind the true (or absolute) maximum sustainable yield corresponding to the level of the fishing mortality rate F_{MSY} or the fishing effort f_{MSY} calculated on the basis of analytical or production models.

6. The main positive aspects of the use of the MSY concept in fisheries regulation are the following:

(a) The possibility of establishing quantitative limits;

(b) The relative accessibility of the basic data required for the calculations;

(c) Simplicity and illustrative value.

7. The attraction of using the MSY concept in fisheries regulation is that very high yields can be obtained through the maximum utilization of the productivity of the fishery population.

8. In the meantime, the use in fisheries regulation of the MSY concept in its "true" form, unadapted to the biology of the species and the environmental conditions, has revealed a number of adverse consequences of such regulation for the status of the resources exploited because of certain shortcomings inherent in the concept, which was devised on the basis of both production and analytical models.

9. The use of production models to devise a regime of regulation over a prolonged period of time has the following characteristics which reduce the reliability of the figures calculated for MSY, which, in turn, results in adverse consequences for the resources exploited:

(a) The proposed balance between the stock and the fishery, if not adjusted in the light of their current status, leads to forecasts which only roughly approximate conditions of equilibrium;

(b) The harvesting of the stock to the level of MSY with the consequent introduction of small annual categories into the fishing industry over a number of years leads to the depletion of the stock;

(c) The use of that type of model has been made more difficult by the need to standardize catch per unit effort or to standardize fishing effort developed by various types of fishing equipment (trawls, lines, purse seines, cast nets, traps, etc.).

10. The particular features of the use of analytical models which give rise to difficulties in the use of MSY and reduce the reliability of the figures calculated for it are as follows:

(a) The need for significant expenditure in order to obtain sufficiently reliable biological information characterizing the stock of the fishery;

(b) The need for the provisional adoption of certain preconditions to ensure the continuing recruitment of a stock within the limits of a wide range in the size of the stock, the parameters of growth, natural mortality and the stable status of a fishery;

(c) The need for adjustments in the level of MSY in the event that it is calculated in terms of a low level of recruitment over a number of years; in that event, fishing at an unadjusted level of MSY would result in overfishing;

(d) The complexity of using the MSY concept in respect of fish with a short life cycle, for which the curve of the possible yield has no maximum and the determination of F_{MAX} is difficult; in that event, fishing at the level of an inaccurately determined F_{MAX} may lead to a serious depletion of the stock, reduced recruitment and lower catch per unit effort;

(e) The difficulty in applying the MSY concept in respect of fish with a long life cycle in the event that fishing is directed towards young fish of the recruitment group.

11. Thus, the use of MSY in its "true" form as a basis for fisheries regulation is more acceptable for species with a relatively long life cycle, in which case fishing should focus mainly on the balance of the stock and the size of the recruitment should not undergo significant fluctuations from year to year.

12. The use of the VPA and SPA methods and cohort analysis, although allowing a more reliable calculation of the annual change in MSY on the basis of fluctuations in recruitment, does not, however, on the whole, lead to improved results in the application of a system of regulation based on the concept of MSY.

13. At the same time, articles 61 and 119 of the United Nations Convention on the Law of the Sea state that the maximum sustainable yield is "qualified by relevant environmental and economic factors, including the economic needs of coastal fishing communities and the special requirements of developing States, and taking into account fishing patterns, the interdependence of stocks and any generally recommended international minimum standards, whether subregional, regional or global". The United Nations Convention thus provides for the use of the MSY reference point for fisheries regulation not in its direct sense, but in a more flexible, weaker sense.

14. In view of the need to establish reference points for fisheries regulation in keeping with the standards and recommendations set out in that international legal instrument, which is of particular importance at the present time when stocks of many species of fish are being reduced, it would be advisable to refrain from regulating fisheries in the economic zones and the high seas on the basis of the concept of MSY in its "true" form. The use of the MSY reference point, modified in various ways in line with the aims of stock conservation and fisheries regulation, should be introduced into the general practice of international fisheries regulation, including the regulation of that part of the straddling fish stocks which extends beyond the economic zones.

15. There are various possible modifications which would, on a sound basis, establish the recommended yield at a level lower than MSY. That would to some degree protect the stock from possible over-harvesting.

16. One such modification which would allow an artificial reduction in the estimates based on the MSY concept and lead to a scaled-down fisheries regime is the F_{OPT} term of reference, generally known as $F_{0.1}$. This term of reference is the optimum fishing mortality rate, lower than the maximum mortality rate, F_{MAX}, corresponding to MSY.

17. In our view, at the present time, taking into account the possibilities of data collection and the accessibility and reliability of data, the concept of MSY, modified with the help of the $F_{0.1}$ or $f_{0.1}$ term of reference, should form the basis of methods for the conservation and rational utilization of resources.

18. At the same time, it is known that the level of the optimum intensity of fishing must change in proportion to the size of the stock, variations in which may be conditioned by fluctuations in the number of generations. In this connection, the use of the fixed values of $F_{0.1}$ may result in serious errors in establishing the size of the catch. One way out of this situation, in our view, would be to provide annual estimates of the possible catch, using the optimum intensity of fishing established specifically for each level of stock.

19. Another way of resolving the problem would be to use the term of reference of the acceptable biological catch (ABC), which is established for each year separately mainly on the basis of annual variations in the size of recruitment. The determination of ABC could be based on the size of the parent population that could ensure a maximum level of recruitment. The size of the parent population can be determined, for example, by means of a direct calculation. To increase the size of the population in a situation where there has been over-fishing, it would be advisable to establish ABC at a level known to be lower than MSY. The flexibility of the ABC term of reference would make the management of the "stock-fisheries" system effective with respect to fish populations with a short or medium-length life cycle.